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SURVEYING OUR PUBLIC LANDS . . .

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UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Land Management
1969

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Dear Reader:

This pamphlet tells the story of public land surveys in the United States. Surveying our public lands is one of many Bureau of Land Management responsibilities. The Bureau (BLM) has the sole responsibility for the conservation and sound use of more than 477 million acres of public lands. This area stretches from the submerged lands off the coast of southern Florida to the permafrost of far-northern Alaska.

The conservation job of BLM includes range management, forestry, mining and mineral leasing, public land records, surveys, recreation, fire fighting, and many other activities.

In a recent year the resource harvest from BLM lands included enough timber to build more than 100,000 average homes. Enough oil to heat more than 5 million homes for a year. Enough forage to feed more than 11 million livestock and big game for an average of 4 months. Receipts to the United States Treasury from BLM activities have amounted to over $2 billion.

In taking care of the public lands the Bureau of Land Management works to use the land and natural resources wisely, to prevent waste, and to rebuild and improve our public lands for the present and the future.

Sincerely yours,

BUREAU OF LAND MANAGEMENT

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Surveying Our Public Lands . . . .

History. . . .

Surveying is an ancient art whose beginnings are lost in the shades of history. Many of its basic principles date back to the early Egyptians. Though the specific methods and equipment the Egyptians used for surveying have not survived, we do know their measurements were remarkably precise.

The Great Pyramid of Gizeh (Khufu), for example, is laid out with its base lined up with the four points of the compass. The base of the pyramid was so accurately measured that the four sides, which are 764 feet long (over 9,000 inches), have an average error of only $\frac{6}{10}$ inch in length and 12 seconds in angle from a perfect square. The pyramid was built about 4700 B.C., nearly 7,000 years ago!

The Egyptians were also very much concerned with the survey of property boundaries for taxing purposes—a job that had to be done many times over in the wake of the annual floods in the Nile Valley.

In the Bible there is a reference to preserving and honoring the corner monuments marking the boundaries of lands (*Proverbs* 22: 28). The remnants of irrigation systems laid out by surveyors in Biblical times are still to be found in the Middle Eastern countries. Also a planned system of surveys was used throughout much of the Roman Empire.

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Surveying is an honorable and highly respected profession. From the days of Euclid down through the ages to the present time, mathematicians and astronomers who have engaged in the practice of surveying have been set apart as men of special qualifications and integrity.

In the United States, many men who have taken a leading part in the formation and development of our way of life have come from the ranks of surveyors. George Washington was a surveyor for Lord Fairfax and laid out the boundaries of many farms and woodland areas on the large Fairfax estate in Virginia. Thomas Jefferson took an active part in the development of the plan for the survey of the public lands. William Burt and his sons took a very active part in the development of the Midwest; they worked on the construction of such works as the canal and locks at Sault Sainte Marie, Mich., which contributed so greatly to transportation on the Great Lakes.

Three types of surveying . . . .

Surveying may be broadly defined as the art of measuring the earth's surface. Surveying is divided into three general classes: (1) Geodetic surveys measure the shape and size of the earth. (2) Topographic surveys measure the features of the earth's surface, such as hills, valleys, rivers, streams, lakes, and the location of roads, and railroads. (3) Cadastral surveys determine and lay out the boundaries of parcels of land for defining individual ownerships.

After the Revolutionary War ended and the Government of the United States was being formed, the new States ceded their western land claims to the central Government. Soon additional areas were added to the public domain and the United States began to grow.

Growth of the public domain . . . .

In 1803 President Thomas Jefferson arranged to buy a large amount of land from France. This is known as the Louisiana Purchase. It amounted to over 500 million acres and included most of the land from the Mississippi River west to the Rocky Mountains, except what is now the State of Texas. The Louisiana Purchase cost the United States about $23 million.

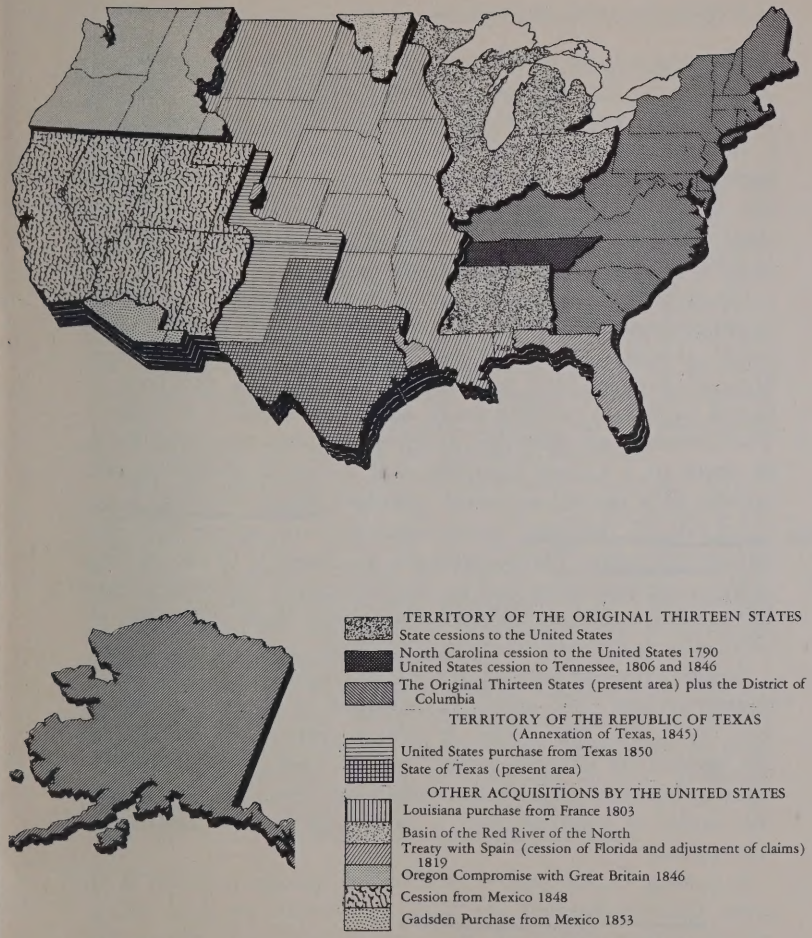
Then in 1819 the land that is now Florida became part of the United States. Texas became part of the United States in 1845. A year later the United States signed a treaty with Great Britain which added the area that is now the States of Oregon, Washington, and Idaho. This treaty is known as the Oregon Compromise.

In 1848, just one year before the discovery of gold in California, the United States obtained from Mexico the lands that are now the States of California, Nevada, Utah and parts of Arizona, Wyoming, and Colorado. The Gadsden Purchase in 1853 added what is now southern Arizona.

The last large addition to the land area of the United States came in 1867 when the United States purchased Alaska from Russia. The area of Alaska amounted to over 375 million acres (that is about one-fifth as big as the rest of the United States). It cost about $7 million.

With these additions, the public domain stretched from the west boundary of Pennsylvania to the Pacific Ocean, from the Canadian border to the Gulf of Mexico, and it included Florida and Alaska. Altogether it embraced over 1 billion 800 million acres.

The Congress recognized in the very early days that an orderly plan for the survey and settlement of the public domain was necessary. It was from this realization that the rectangular system of public land surveys was developed.

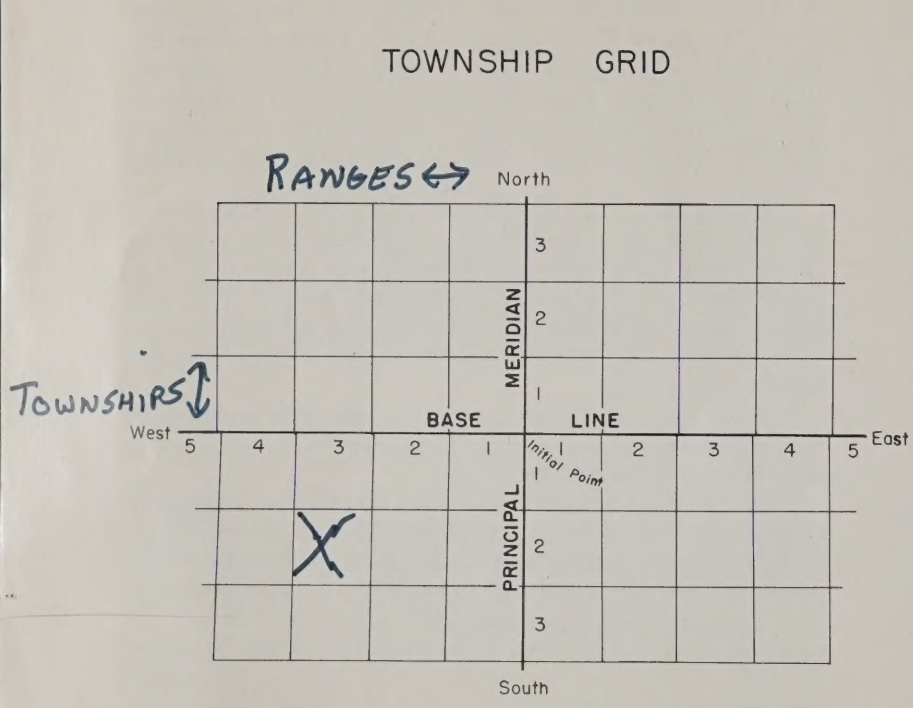

TERRITORY OF THE ORIGINAL THIRTEEN STATES
State cessions to the United States
North Carolina cession to the United States 1790
United States cession to Tennessee, 1806 and 1846
The Original Thirteen States (present area) plus the District of Columbia
TERRITORY OF THE REPUBLIC OF TEXAS
(Annexation of Texas, 1845)
United States purchase from Texas 1850
State of Texas (present area)
OTHER ACQUISITIONS BY THE UNITED STATES
Louisiana purchase from France 1803
Basin of the Red River of the North
Treaty with Spain (cession of Florida and adjustment of claims) 1819
Oregon Compromise with Great Britain 1846
Cession from Mexico 1848
Gadsden Purchase from Mexico 1853

On May 7, 1784, a committee of the Continental Congress worked out a plan for locating and selling lands in the western territory. The committee was composed of Thomas Jefferson of Virginia (chairman), Hugh Williamson of North Carolina, David Howell of Rhode Island, Elbridge Gerry of Massachusetts, and Jacob Read of South Carolina. This plan was entirely in Jefferson's handwriting and there is every reason to believe that he was the author. The document was debated in Congress. On May 20, 1785, it was adopted in modified form.

The first surveys under this law took place in Ohio where the west boundary of Pennsylvania crossed the north boundary of the Ohio River. The first township was surveyed by Absolom Martin of New Jersey in 1786. The State of Ohio was the testing ground for the new type of surveys, and some changes were made in the law as a result of experience gained in the surveys in that State.

The main surveys in Indiana started about 1805 and by that time the system was well settled. This system has been extended westward to the Pacific Ocean.

When this plan of survey was established by the Continental Congress in the land Ordinance of May 20, 1785, it was unique in that no pattern for it existed anywhere else in the world. The plan developed three new theories in land administration. First, the principle of "survey before settlement"; second, the principle of a mathematically designed plan to be followed throughout the entire area of the public domain; and third, the creation of a standard land unit, the section, of uniform shape and area and with boundaries physically marked on the ground. These features did not follow any plan in use within the area of the original Colonies in America, where land locations were made in irregular form and without any orderly plan.



The rectangular survey system . . . .

The first step in subdividing public lands is to establish an initial point, the latitude and longitude of which is known. Then, a true north and south line called a "principal meridian" is run through the initial point and marked on the ground. Next, a line is run east and west from the initial point. This line is called a "base line" and it is perpendicular to the principal meridian. There are now 36 principal meridians located in different parts of the United States.

On either side of the principal meridians the land is laid out in approximately square units, looking very much like a checkerboard. These units are called "townships." Their boundary lines are 6 miles long and run north-south and east-west. A tier of townships running north and south is called a "range." The townships are described as being so-and-so townships north or south of a named base line and so-and-so townships east or west of a named principal meridian. Each township is divided into 36 "sections" approximately 1 mile square and containing 640 acres. The sections are numbered 1 to 36, starting in the northeast corner and moving alternately right to left then left to right, ending in the southeast section. Each section can be located by its number, township and range.

Sections may be further divided into quarter sections. Each quarter section (160 acres) is identified by its compass direction—NE., SE., SW., NW. A section normally is marked on the ground by 8 monuments: one at each corner and one midway between each corner monument. The exact location of the corner is stamped into a brass cap on the top of the monument.

A quarter section can be divided into quarter-quarters of 40 acres. Quarter-quarters, or "40's" as they are so often called, can be further subdivided into areas as small as 5 acres, or 2½

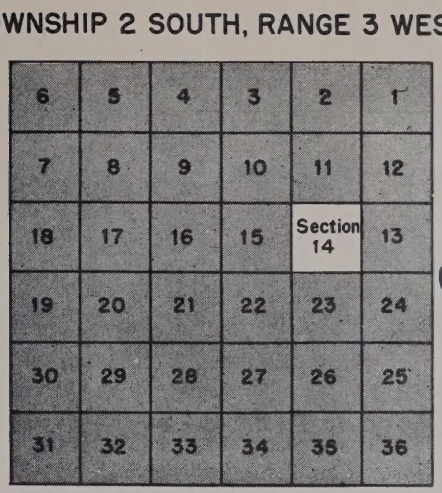
acres, or 1¼ acres. Normally the smallest legal subdivision is the "40."

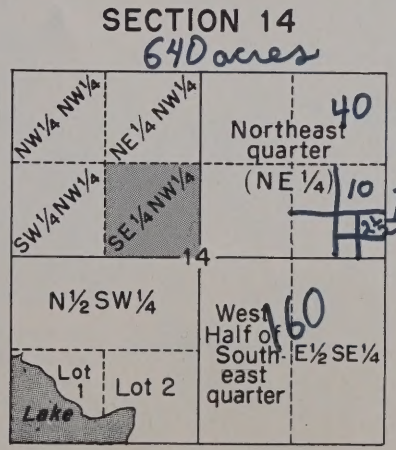
Because of the shape of the earth principal meridians come closer together as they extend toward the North and South Poles. To adjust for this correction lines are run every 24 miles.

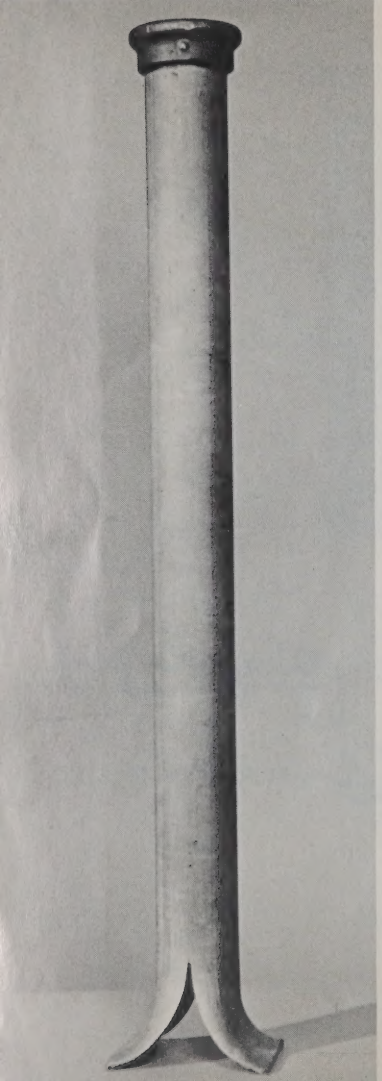
Under the rectangular survey system it is very easy to describe and locate any one parcel of land. There cannot be another parcel of land with the same identification. In order to avoid writing out a lengthy description a shorthand method of describing has been devised. For example, in the illustration the shaded township is located two townships south of the base line and three ranges west of the principal meridian. In short form, the location of the shaded township would be written "T. 2 S., R. 3 W." In formal land descriptions it is also necessary to include the name of the principal meridian.

The unshaded part of the first illustration on page 7 would be described as "sec. 14, T. 2 S., R. 3 W." and the name of the principal meridian. Although the name of the State is not required, it is usually added for convenience. One of the advantages of this system of land description is that the method allows land to be described by very small legal subdivisions without an actual detailed field survey.

Quarter divisions of a section of land are known as "aliquot parts." An aliquot part is always described in relation to the four points of the compass. In the lower illustration on page 7 the shaded portion would be described as the "southeast quarter of the northwest quarter (SE¼NW¼) sec. 14, T. 2 S., R. 3 W." and the name of the principal meridian.







CORNER MONUMENT. The exact location of the corner is stamped on top. The bottom is spread out to prevent pulling the post from the ground.

Metes and bounds surveys . . . .

Before the rectangular survey system was established all land was described by measurements and boundary markers (usually called metes and bounds descriptions). Metes and bounds descriptions are still used in the United States. In fact, the United States and Canada are the only countries in the world that have rectangular systems of survey. All other countries use metes and bounds surveys.

A metes and bounds description begins at a certain well defined point and then follows the exterior boundaries by courses (directions) and distances. The starting point is described in relation to a survey marker or monument, or to a natural marker such as the mouth of a stream, a bridge, a road, or a prominent outcropping of rock. The starting point may also tie in with a road, a highway, or a milepost.

The starting point is plainly marked on the ground, with a pile of stones, a tree blazed on four sides, or some other prominent marker. Where it is not possible to tie the starting point in with a survey monument or marker, the latitude and longitude should be given with as much accuracy as possible. Latitude and longitude can be read from a good map of the area.

The tract is described by all of its boundaries. For example, here is a metes and bounds description.

> *Beginning at the southeast corner of township 7 south, range 5 east, of the Boise Meridian, Idaho, proceed 6 miles east, thence 5 miles north to the point of beginning, a pile of rocks 105 feet southeast of a fork in the creek, thence west 20 chains, thence north 20 chains, thence east 20 chains, thence south 20 chains to the point of beginning.*

A complete legal description of the same tract under the rectangular survey system would be SE¼SE¼, sec. 1, T. 7 S., R. 5 E., Boise Meridian, Idaho. In longhand this says "the southeast quarter of the southeast quarter of section 1, township 7 south, range 5 east, Boise Meridian, Idaho."

The survey of the public lands was started in 1785. It has continued since that date. Surveys were originally made on a contract basis at so much per mile of line actually surveyed. 1910 the contract system was abolished. Since then the surveys have been performed by a corps of expert surveyors employed by the Federal Government.

About 74 percent of the total area of the original public domain has been surveyed. Nearly 466 million acres remain unsurveyed, of which more than 76 percent is in Alaska.

The surveying crew . . . .

Present-day surveying crews have the advantage of the most modern developments in equipment and methods. The survey parties live in field camps near the survey project. They often live in house trailers which are equipped with gas for heating and cooking, running water, and electric light. Transportation from the field camp to the location of the day's work is generally by truck or jeep. In the more remote and inaccessible regions airplanes or helicopters are now used. Modern electronic devices are frequently used for measurement of distances, particularly where the distance between points is several miles.

The "three range electronic measuring system" has been developed for use in conjunction with the hoversight. The hoversight is used in helicopters hovering over a fixed point while observations for distance and angles are made.

A field survey crew normally consists of five or six men. The party chief runs the transit in projecting the line being surveyed

and supervises the activities of the other members of the survey party. Two members called "chainmen" measure the distance along the line being surveyed with a long steel tape. The head chainman takes the front end of the tape and goes out along the line, measuring the distance by each tape length. The rear chainman holds the other end of the tape at a point from which the measurement is made in order to avoid errors.

There are usually one or two axmen on a crew; they clear the underbrush and small trees so that the party chief will have a clear sight along the line and the chainmen will be able to pull the tape straight without interference. In addition, a flagman is out in front of the rest of the party. He marks points on the line by signal from the chief of the party operating the transit.

BLM cadastral surveyors . . . .

The Bureau of Land Management employs a large number of permanent cadastral surveyors and seasonal survey aids. A permanent cadastral surveyor should be a college graduate holding a bachelor of science degree in an appropriate field of study.

Most field surveys can only be done during periods of favorable weather; therefore, BLM hires many seasonal workers every summer. Many survey aids are college students working during their summer vacations. To qualify for survey aid you must be at least 18 years old and in good physical condition.

For more information about employment opportunities in cadastral surveying write the Bureau of Land Management, U.S. Department of the Interior, Washington, D.C. 20240.

Protracted surveys . . . .

Recently, there has been a great increase in mineral leasing of public lands in Alaska, but less than 1 percent of the new

HELICOPTERS are often used in remote regions to transport BLM survey crews.

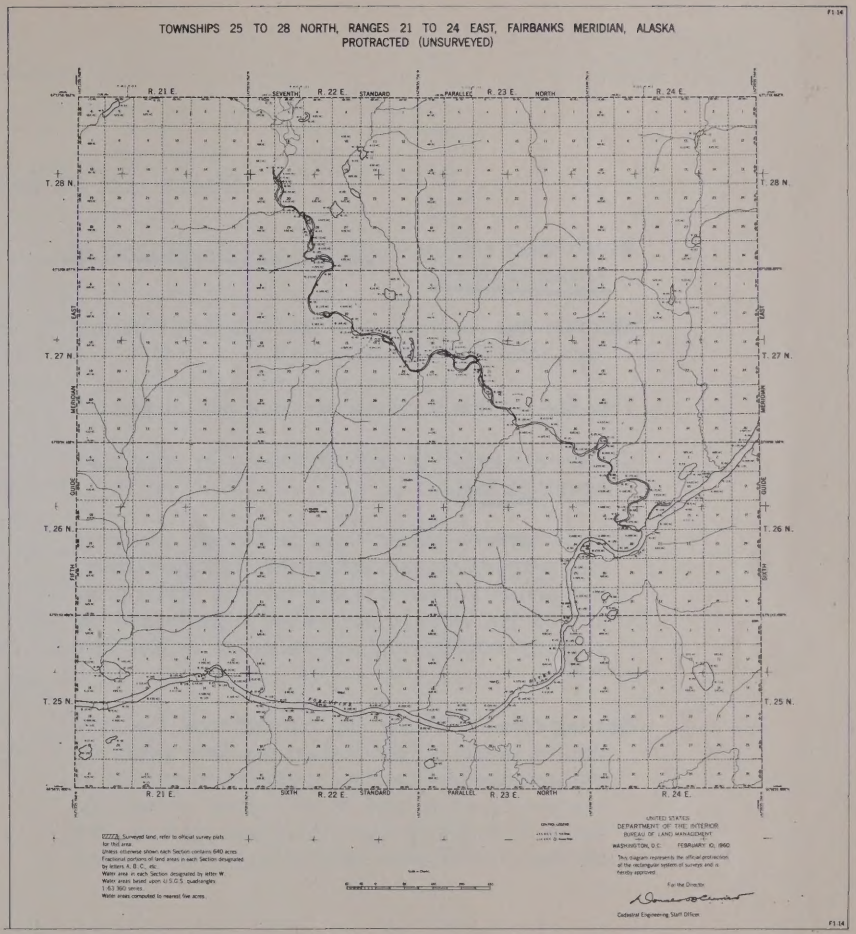
State has been surveyed. To simplify mineral leasing in Alaska and in the unsurveyed areas of other States as well BLM adopted a system of "protracted surveys"—lines drawn on maps that follow the public land survey system, even though the boundaries have not yet been laid out on the ground. Protractions help in locating oil and gas leases and they provide a means for recording actions dealing with public lands.

Protractions will not take the place of the final official survey but they will provide a present basis for many types of land management.

Cadastral surveys using photogrametry . . . .

The BLM continually explores new methods and techniques for surveying the public domain. Photogrametry is being employed as a tool to execute original surveys, dependent resurveys, meanders of bodies of water, and townsite surveys. It is quite common for BLM to use aerial photographs to strengthen its findings in legal matters regarding older surveys.

The unsurveyed areas of the public domain are in the more remote and mountainous areas of 12 western States. The largest unsurveyed area is in Alaska. Many difficulties will have to be overcome in carrying out the remaining surveys. The work will require men in top physical condition who are not afraid of the hardships involved.



PROTRACTED SURVEYS aid in setting up management programs for areas not yet reached by BLM cadastral surveys.

Short List of Surveying Terms

Bench mark (B.M.)—a definite permanent point of known elevation.

Meander line—a traverse of the margin of a permanent natural body of water.

Traverse—a line surveyed across a plot of ground.

Chain—a measuring unit often used by surveyors; equals 66 feet.

Witness corner—blazed trees or corners similar to true property corners established in a given direction and at a given distance from an actual property corner. Witness corners aid in the location of property corners and are recorded in the field notes.

Bearing tree—a blazed and marked tree, the location of which is recorded in the field notes for the purpose of locating a property corner. At all township corners and at all section corners on range or township lines, four bearing trees are marked. For quarter sections and meander corners two bearing trees are marked, one within each of the adjoining sections.

Original survey—a cadastral survey which creates land boundaries and establishes them for the first time.

Resurvey—cadastral survey to identify and remark the boundaries of lands which were establishd by an earlier survey.

Survey plat—a graphic representation drawn to scale depicting the actual survey as described in the official field notes.

Field notes—the permanent detailed record made by a surveyor as he is in the process of establishing a boundary. Actually, a kind of "diary" in which the surveyor records all of the details about the survey, including land forms, distances, directions, and other physical data. This data is refined and pertinent material is included in the final field notes which after approval constitute the "legal" record of the survey.

36 T. 13N., R. 10W.

Between Sections 29 and 30 S½ MILE

Date Nov 2. 1953

MEASUREMENT ON SLOPE	VERTICAL ANGLE	CORRECTION FOR SLOPE	HORIZONTAL DISTANCE	PLUS DISTANCE	DIFFERENCE IN ELEVATION
CHS.		LKS.	CHS.		FT
500	-13°	-13	487	•	-74
500	-16¼°	-20	480		92
320	-24½°	-29	467		166
500	-17°	-22	391		70
266	-6°	-2	1258		252
			478		40
			1736	+ 0.94	352
			264		18
			2000		-370 FT
500	-10°	-8	492		
			2492	+ 0.68	-57
290	-1°	0	290		-3
			2782	-0.22	-60
				+1.18	
500	0	0	500		
			3282	+ 2.18	
500	+3°	-1	499		
			3781		+20
175	-	-	175		
			3956		

Local BTs: R. OAK, 5" N 36½°E, 26½ LKS, SMALL BLAZE
SPOTTED OAK, 18", S 73¼ W, 11 LKS - 3 HACKS
W. OAK, 6", N 24½° W, 23 LKS - SMALL BLAZE

New BTs: PINE, 6", S 42°E, 73 LKS, MKD. ¼ S29 BT
W. OAK, 7" N 74½° W., 32½ LKS, MKD. ¼ S30 BT

COLD, BLUSTERY OVERCAST. TEMP. 7 a.m. 48° NOON 55° 4 p.m. 56°

Random Course N. 1° 30' E.

True Course N. 1° 36' E, 39.56 CHS.

37

DESCRIPTIVE NOTES

DISTANCE	ITEMS
	π: STEVENS, ROD: WALLACE, CHAIN: POGUE, AXE: MALLOW } FROM PT. FOR COR OF SECS 30/29/31/32 (SEE PG. 34) THENCE OVER RUFF MTN, THRU TIMBER & UNDERBRUSH. DESC. STEEP ROCKY NE SLOPE.
18.30	DP. DRAIN. ESE. N 60 E FROM SW.
20.00	SET SD. STAKE FOR TEMP ¼16 COR.
11/8	MOVE: 22 S. 3 E. } SET PC. OF BIG RAIL, 3' LONG, 18" IN GRD.
	CONTINUE DESC. OF NE SLOPE - NOT SO STEEP.
25.60	R. BANK, TOMAHAWK CREEK, 100 LKS. WIDE, 5' DEEP. CSE SE. FROM N 15° W. FOOT OF SLOPE.
27.60	L. BANK.; ENTER BOTTOM OF OLD FIELDS - BRUSH AND THICK BRIARS!
29.00	W. EDGE OF OLD FIELD, FROM SE. AND ALONG LINE.
35.00	NW. COR. OF FIELD; BACK TO BRUSH AND BRIARS; ASC. GENTLY SW. SLOPE
39.56	AT A PT. 7 LKS E. FND ¼ SEC. COR. FROM OLD BTS: BLACK GUM, 24", N 4½ W., 34 LKS. (WITH BIG BLAZE) STUMP HOLE, S. 41°E., 37 LKS (DM)
11/8	AT PT. FOR ¼ COR, SET 2½" I.P., 28" LONG 22" IN GRD., MKD. ¼ S30 | S29 1953

FIELD DAIRY for the resurvey of the south ½ mile of the line between sections 29 and 30.

Official field notes for the resurvey of the south ½ mile of the line between sections 29 and 30

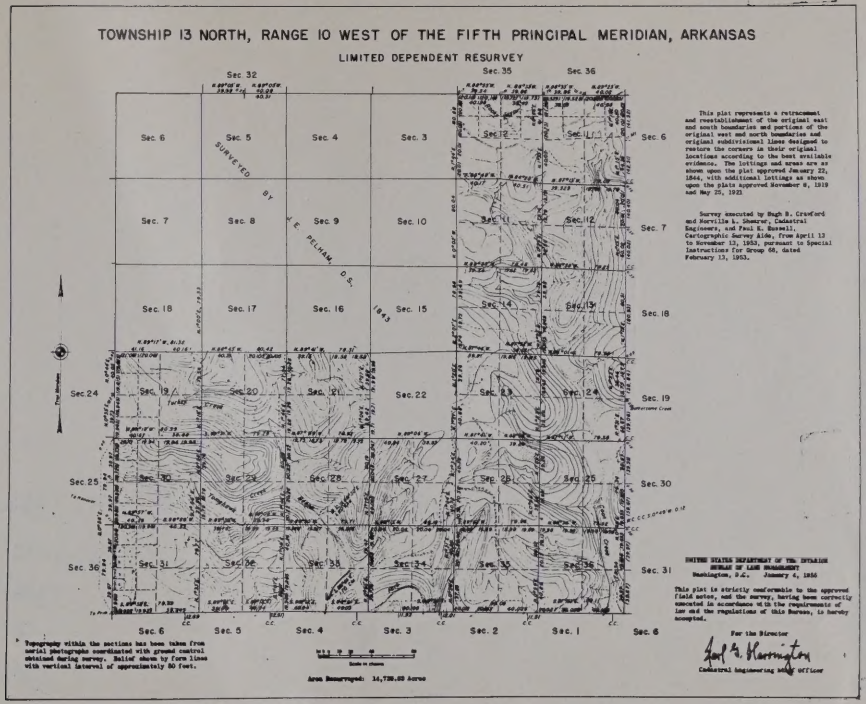
Limited Dependent Resurvey,

T. 13 N., R. 10 W., 5th Prin. Mer., Arkansas

Chains	
	N. 1°36′ E., bet. secs. 29 and 30 (S.½ mile). Over rough mountainous land, through timber and undergrowth, descend 370 ft. over steep rocky slopes to 1/16 sec. cor.
18.30	Deep drain, course N. 60° E. from SW.
19.10	A local corner, a stone 8 x 12 ins., projecting 18 ins. above the ground, bears W., 4 lks. dist.
19,78	The point for the S 1/16 sec. cor. of secs. 29 and 30, at proportionate distance.
	Set a section of bed rail, 3 ft. long, 18 ins. in the ground.
	Continue descent of NE. slope, 60 ft.
25.60	Right bank of Tomahawk Creek, 100 lks. wide, 5 ft. deep, course SE. from N. 15° W.
27.60	Left bank of creek; enter bottomland and ascending 20 ft. out of same to ¼ sec. cor.
29.00	W. edge of old abandoned field, bearing SE. and N., along line.
35.00	NW. cor. of field.
39.56	The point for the ¼ sec. cor. of secs. 29 and 30, as determined from the remains of the original bearing trees:
	A black gum, 24 ins. diam., bears N. 41° W., 34 lks. dist., with big, open blaze.
	A dim stump hole, bears S. 41° E., 37 lks. dist.

Chains	
	At the corner point
	Set an iron post, 2½ ins. diam., 28 ins. long, 22 ins. in the ground, with brass cap mkd.
	S 30 ¼ S 29 1953
	from which
	Local bearing trees:
	A red oak, 5 ins. diam., bears N. 36½° E., 26½ lks. dist., with small blaze.
	A spotted oak, 18 ins. diam., bears S. 73¼° W., 11 lks. dist., with three hacks.
	A white oak, 6 ins. diam., bears N. 24¼° W., 23 lks. dist., with small blaze.
	And new bearing trees:
	A pine, 6 ins. diam., bears S. 42° E., 73 lks. dist., mkd. ¼ S 29 B T.
	A white oak, 7 ins. diam., bears N. 74½° W., 32½ lks. dist., mkd. ¼ S 30 B T.
	N. 0° 28′ E., beginning new measurement.
	Ascend 420 ft. over rough, steep and rocky SW. and S. slopes.

PLAT OF SURVEY in a BLM Land Office. The approved field notes on the opposite page apply to the south half of the line between sections 29 and 30.


TOWNSHIP 13 NORTH, RANGE 10 WEST OF THE FIFTH PRINCIPAL MERIDIAN, ARKANSAS
LIMITED DEPENDENT RESURVEY
Sec. 32
Sec. 35
Sec. 36
Sec. 6
Sec. 5
Sec. 4
Sec. 3
Sec. 7
Sec. 8
Sec. 9
Sec. 10
Sec. 18
Sec. 17
Sec. 16
Sec. 15
Sec. 24
Sec. 20
Sec. 21
Sec. 22
Sec. 19
Sec. 25
Sec. 29
Sec. 28
Sec. 27
Sec. 30
Sec. 36
Sec. 31
Sec. 32
Sec. 33
Sec. 34
Sec. 35
Sec. 31
Sec. 6
Sec. 5
Sec. 4
Sec. 3
Sec. 2
Sec. 1
SURVEYED BY J. E. PELHAM, D.S., 1953
This plat represents a retracement and reestablishment of the original east and south boundaries and portions of the original west and north boundaries and original subdivisional lines designed to restore the corners in their original locations according to the best available evidence. The lottings and areas are as shown upon the plat approved January 22, 1844, with additional lottings as shown upon the plats approved November 8, 1919 and May 25, 1922.
Survey executed by Hugh B. Crawford and Norville L. Shearer, Cadastral Engineers, and Paul K. Russell, Cartographic Survey Aide, from April 13 to November 13, 1953, pursuant to Special Instructions for Group 66, dated February 13, 1953.
Topography within the sections has been taken from aerial photographs coordinated with ground control obtained during survey. Relief shown by form lines with vertical interval of approximately 50 feet.
Area Resurveyed: 14,738.65 Acres
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Washington, D.C. January 4, 1956
This plat is strictly conformable to the approved field notes, and the survey, having been correctly executed in accordance with the requirements of law and the regulations of this Bureau, is hereby accepted.
For the Director
Cadastral Engineering Officer

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